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SETTING AN INNOVATIVE MASTER DEGREE ON ENERGY SUPPLY FOCUSING ON ISOLATED AREAS – THE MESfIA ERASMUS+ PROJECT

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Abstract. *Mastering Energy Supply focusing on Isolated Areas (MESfIA) Erasmus+ Capacity Building project, aims to provide high quality postgraduate education on energy supply systems for engineers and graduates from science departments, aiming to have activity or to be employed in projects in countries with many isolated areas and insular systems. It is a transnational co-operation activity between Europe and South-East Asian Countries (namely in our case Thailand, Vietnam and Indonesia) to improve capacity of Postgraduate Students in S.E. Asian Universities. Energy efficiency is among the items to be addressed in this training.*

Keywords: Power Systems, Electrical Grids, Island Networks, Postgraduate Training curricula, Transnational collaboration.

1. Introduction

Access to affordable and reliable energy supply is a necessary prerequisite to the economic development and poverty alleviation [1]. It seems awkward to realize that about 840 million people (11% of the world population) do not have access to electricity [2], 95% of them in sub-Saharan Africa and developing countries in Asia. In Southeast Asia alone, 125 million out of 625 million residents lack access to stable electricity [3]. These people quite often reside in either physical islands, mostly in Indonesia, or isolated areas that electrically can be considered as islands. Taking into account, that electricity leads to a number of quality-of-life improvements, such as improved communications, educational attainment, improved health services and easier access to potable water, access to electricity services has been explicitly identified by the World Summit on Sustainable Development (WSSD) as an essential for achieving the UN Millennium Development Goals for halving poverty by 2015 in the world's poorest countries [4]. Additionally, the UN sustainable Development Goal n°7 [5] aims to “Ensure access to affordable, reliable, sustainable and modern energy for all”. Clearly, improving access to energy for all should be considered as a key target for the realization of this Goal.

This is further important for remote or/and island areas and rural electrification campaigns clearly serve this purpose. Such areas may include villages away from the grid, in forest or mountainous areas but mostly island areas. These areas share a few common characteristics that induce difficulties in satisfying energy demand at best at similar cost with people residing in large metropolitan areas or even for with similar reliability indices. These areas may have more frequent and longer electricity cuts, even though some of these may be even interconnected to stronger grids, with rather weak interconnections, though. Sometimes a single fault that in an interconnected power system would remain unnoticed, in such areas may even lead to black out of the power system.

At the same time, limited fuel resources and less efficient operating points of operation increase the energy cost in these areas which can be significantly higher compared to the mainland [6]. Moreover, high electricity demand usually appears during the touristic periods with even more increased peaks in specific times of the day. This notable seasonality and periodically requires an advanced and adaptive approach including both energy management and efficiency but also flexible energy production. To increase complexity, these areas are usually

located in fragile environment areas. Thus, transportation and use of fuel harms such an environment especially in islands where sea environment is also linked. Potential accidents like oil spills, vessel sinking, fires, chemical accidents, etc. are the causes of severe damages to what are the two main income capital chapters, fishing and tourism, the major activities of the population as confirmed by the questionnaires developed within the MESfIA project. An additional issue is that oil has not only high transportation cost, but also significant environmental footprint inducing air pollution, water quality issues.

The declining cost of Renewable Energy Resources (RES) is opening new opportunities to achieve access and reduce reliance on costly diesel generators in isolated areas [7]. Clearly RES, especially combined with storage, has provided significant boost to rural electrification in various areas of the world and in bibliography there is a number of exceptional cases where local or regional cooperation has improved electrification [8]. The most successful example is the use of Solar Home Systems (SHS) to provide minimum lighting and use of small appliances [9]. One can distinguish technical and non-technical barriers, requiring special and creative techniques to be followed for the exploitation of RES to be increased [10].

However, beyond these barriers, a main issue is still lying on the availability of skilled engineers and technicians in the immediate neighbourhood. In all these areas difficulty of specialized assistance to access rapidly the place require highly qualified personnel to be available on site. Understanding these peculiarities, barriers and understanding the potential solutions is one of the cornerstones for improving energy supply focusing on isolated areas. In fact, it is commonly accepted that the more skilled technicians and engineers available, the lower the danger of prolonged power cut is. Erasmus+ Capacity building MESfIA (Mastering Energy Supply focusing on Isolated Areas) project is ambitious to hedge this gap.

The objective of the project is presented in Section 2 while in Section 3 the preparation phase along with the major training axes are presented.

2. The MESfIA Project-Scope and Objectives

The aim of the MESfIA project is to provide high quality postgraduate education on energy supply systems for engineers and graduates from science departments, aiming to have activity or to be employed in projects in countries with many isolated areas and insular systems. Education on various aspects of Intelligent Energy Systems, which have also become a reality in the partner countries, should cover Energy Management, Renewable Energy Sources (RES) utilization, Energy conservation, intelligent materials application to energy sector and Demand Side management. However, there is need for more systematic training on the aforementioned issues for application on the fragile environment of isolated areas taking into account the peculiarities of the island power systems. This is where MESfIA emphasizes and the innovative character is to provide via existing or new MSc programs of the Partner countries the capability to apply specific skills to help in the more efficient energy supply of isolated areas. It has been observed that the establishment of a master program that targets in satisfying needs linked to specific geographic conditions tends to make their students more willing to move to areas where their specialization will be better adapted, promising and needed.

In that way, MESfIA combines all of the above elements, by suggesting the establishment of a number of Master Courses, combining the existing experience of the EU and Asian countries in these issues. The MESfIA Master, aiming to start in late 2020 in Asian Universities has a clear ambition to transfer the knowledge to countries of South-East Asian regions where the renewable energy potential is huge, and explore novel approaches in educating high quality specialists in RES, intelligent energy management and consumption reduction.

2.1 The MESfIA consortium

European and South East Asian Universities co-operate in order to develop the necessary adaptations to existing MSc programs in South East Asia Universities or develop a new stream of Courses focusing on Energy issues especially of isolated areas. Additionally, existing courses will be adapted to serve these specific needs by suitable examples.

As the project has a broad scope of targeting academic, industrial and civilian sectors, the consortium partners have been selected on the basis of their know-how and the target group they can approach. The members of MESfIA consortium come in great part from island Areas, i.e. Crete, Canary Islands, Indonesia or have islands or remote areas still un-electrified like Vietnam and Thailand. Four of the academic institutions are based on island areas. All institutions, but mainly island ones, have had close collaboration for a long time with their local Electrical Distribution Network Operators for the more efficient operation of the autonomous power systems of Crete, Canary Islands and Indonesia, respectively.

In Table 1 the list of the 11 MESfIA's Consortium members is provided along with a map showing the global Dimension of the consortium in Figure 1.

Table 1
The Consortium members

European Partners	Asian Partners
Hellenic Mediterranean University, Greece (Coordinator)	Asian Institute of Technology, Thailand
Eurotraining Educational Organization, Greece	Naresuan University, Thailand
Université Toulouse 3 – Paul Sabatier, France	Institut Teknologi Bandung, Indonesia
Instituto Tecnológico de Canarias (ITC), Spain	Universitas Gadjah Mada, Indonesia
Canary Wharf Consulting Ltd, UK	Nong Lam University, Vietnam
	University of Danang, Vietnam



Fig. 1 – The global Dimension of the MESfIA project.

3. MESfIA activities and expected impacts

To achieve its objectives, MESfIA consortium is developing a large range of activities; some of them are listed below.

- Surveys on related national and international programs and on needs for intelligent energy systems, emphasising on the needs of electrical and/or geographically isolated inland and island areas, following an itinerary that secures the validity and quality of the project based on the mature research of partners. This will help to avoid replications and pinpoint the potential needs mainly of Asia students on such systems. Additionally, will help students and participants prepare state-of-the art and ready to apply methodologies for more efficient and intelligent solutions, for meeting energy demand.
- Formulation of recommendations, based on the results of the survey and the expertise of all participants, regarding both academical aspects and potential technological solutions that better match global and mainly local industry demands. The requirements' identification will point out all the specific areas where the whole system can be “weaved” together achieving smooth integration. The identification of the exact framework, the required tools and the necessary prerequisites will also identify the best educational approach required for each session. Finally, these proposals will result in new courses and proposals for adapting existing ones.
- Capacities building through intense collaboration among all participants staff will be strongly promoted, aiming at enhancing Asian partners capacities, promoting the bonds among European industrial and academic bodies and their Asian counterparts and supporting the generation of innovative solutions to common problems.
- Promotion and advertising campaigns for making programmes activities known to special and wider audiences.

The project focus in the wider South-East Asian countries sharing common culture, making unification of such approaches more effective. Traditional in-class lectures will be applied, in order to maintain the bonding between students and teachers, and this will be enhanced by the participation of teaching staff and experts from European

participants. Live Streaming will be utilized for experiments that should take place at site-specific areas like the TALOS infrastructure, a unique installation site for testing insulators [11].

3.1 Preparation phase

The preparation phase included a literature review of the needs of the local communities in South East Asia, Good practices from other regions of the planet. Feedback from industrial partners and the society was deemed essential in this stage to tailor the program and courses according to the market needs. For this reason, two questionnaires were set up to identify the potential issues of interest for the stakeholders of South East Asia. These questionnaires refer to the social needs and the technical skills that should be available to the trainees of the MESfIA project.

By the response in the social needs it can be identified that the major issues that the people residing in autonomous power systems have to face are Health anxiety and then the energy issues. When discussing the energy issues from the social perspective:

- Among Energy issues, reduced power quality and expensive prices are the issues that worry more the people residing in such areas
- People believe that lack of funding and unclear legislation framework is one of the reasons that impede RES penetration in these areas
- Cooking is not very often based on electricity while for areas not interconnected to the grid, PVs and Diesel gensets are the major sources for providing electricity.

As far as training needs in the energy sector these have been identified as follows:

- Training should focus more on PVs and Energy Storage
- There should be significant emphasis on more practical aspects of training
- Funding and regulatory framework should be explicitly examined.

3.2 Education Material and Curricula development

The consortium has prepared at a first step a detailed planning of training cycles including scheduling and effort management for implementation of training courses in each country, in order to provide postgraduate training mostly on Electrical, mechanical engineers focusing on:

- Realizing the difficulties in Isolated Environments and the associated peculiarities with energy management on such systems
- Training of Engineers at Post Graduate Level so that they can cope with the aforementioned peculiarities and become ready for applying intelligent solutions to energy supply of isolated areas. Some of these solutions could be applied in stronger power systems as well.

Lectures and laboratory exercises will help students understand these topics, adopt them for improving Energy Supply and help in the adaptation of various European Norms in their local environment. Regarding the Pedagogical Approach, suitable modern and well-established methodologies will be adopted, adjusted to the needs and special characteristics of the areas of interest.

Based on the discussions among the partners, bibliographical reviews and the results from the questionnaires, the education material under development in the frame of the project will cover:

- Use of Renewable Energy Sources (RES) has been proven vital for electrification especially in remote areas. Exchange of knowledge of good practices for exploiting RES, adapting to the special characteristics of each environment, such as salinity for islands, will be addressed. There is significant expertise in the consortium regarding management of RES in such areas (e.g. Crete; Indonesia and Canary Islands). Significant focus will be provided to Solar Energy. More interesting on Wind Power exists in Vietnam, the country with the highest wind potential in the area.
- Energy Storage is a key issue for improving energy supply, mainly via more efficient integration of RES into isolated power networks. The students, after the corresponding MSc cycles will be able to understand the value of Energy Storage for energy management and identify potential business models for Energy storage integration based on the legislation. Energy storage is one of the key subjects for which material will be developed.
- Managing of Energy Resources for promoting energy security, emphasizing in power systems of isolated areas. Students will acquire sufficient expertise to combining local knowledge with techniques for analysing energy resources. Students following MESfIA MSc programs will gain the capacity to pinpoint suitable solutions for rural development satisfying local stakeholders.
- Demand Side Management as many isolated areas share as common characteristic low average to peak demand ratio. Meeting Increased peak demand may require significantly more sophisticated solutions. In order to

utilize efficiently power generation facilities in such areas, demand side management can be more essential compared to stronger interconnected power systems. Students will be able to propose methods for controlling peak energy demand of isolated areas based on the special characteristics of each area.

- Increasing energy efficiency may be much more important for isolated areas as the energy cost per unit of energy is expected to be higher. In order to address such issues, educational material on the following sections is under development:
 - Improved lighting performance.
 - More efficient control drives and electrical machines
 - Building Automation ranging from simple automation schemes to Intelligent Buildings
 - More efficient devices including also alternative ways of cooking.
 - More intelligent materials for the building envelope
- Grid Infrastructure demonstrates a critical role for electricity supply, especially insulation materials in coastal and tropical areas. Within the course the fundamental knowledge and methodology for the design, operation and maintenance of Grid is going to be presented. Testing of insulators under various environments will be performed via live streaming in the TALOS test Station [11].
- Protection and automation systems in power grid: Power system protection and automation systems constitute the operation intelligence of a smart grid and ensure its safe, efficient and reliable operation. Within the course, advanced protection and automation schemes will be taught, emphasizing in substations and distribution networks.
- Investment environment for Energy Systems: This group of lectures will address the channels for funding Energy Supply and Saving Systems. Additionally, will provide the trainees with the qualification for more efficient sales of Energy Systems in both National and International level. In the beginning of the project this item was not considered as required, the response of the questionnaires however, revealed the need for increased focus on these items. Special focus should be given on the capability of finding resources for extending the grid.

4. Conclusions

MESfIA will impact a variety of target groups like teaching staff, trainees, technical staff, graduate students and professional groups dealing with power systems. The expected impacts are ranging from local to international level:

- Local level and Regional Level: As the partner Universities are not at the same city for the same country, regional centers of excellence will be created at each country.
- National Level: Each one of the three countries will have the ability to have well-defined paths for providing the knowledge for mastering in energy supply in their isolated areas. This is in line with their needs. Additionally, via the training of trainees and the strong collaboration of EU and Partner countries universities two major areas of the planet will converge in terms of education in power systems.
- International Level: The collaboration among universities will help mutual understanding among EU countries and South East Asia organizations. Workshops and Conferences in the greater area of South East Asia will make EU and especially academic activities widespread known to this area. The organization of lectures will also help EU universities realize potential adaptation of their MSc in their continuous assessment of their own curricula.

By the end of the project, graduates from the MSc program in the Partner Countries Higher Education Institutions (HEIs) should be able to claim their expertise on improving energy supply conditions in isolated areas. An ambition of the project is to attract students from areas with problems in energy supply and prepare them to have activity in the energy sector in their own homeland. As South-East Asia is a bridge between Asia and multi-island Pacific Area, students from these areas could be reached as well as a follow-up of this project.

All partner universities are ready to adapt the new MSc degrees and training programs they offer so that their graduates can claim they have masters focusing on Supplying Isolated Areas. Their role includes preparation of the learning outcomes, course contents and assessment tools. Further, partners from Europe may replicate the methodology to other island countries themselves or on their own islands and enhance their training material. Some of these solutions could be applied in stronger power systems as well.

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